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gets in using it is more disagreeable than with the larger hammer, owing to the more frequent and finer vibrations. I do not believe that with the evidence at hand it is possible to say whether limiting them to the smaller hammer would help directly, but it would perhaps lead the men to use the air hammer less in "roughing out," and if that were the case it would probably indirectly do good.

Besides these obvious measures, there is little doubt that having in mind the above-mentioned factors that are probably active in producing the trouble, an ingenious person of mechanical training and familar with the practical needs in the work could by some study and experiment devise changes in the tools or the hammer, or other changes, that would improve upon the above suggestions; and if the latter were not of the character needed, he could devise means that would be successful. While the disorder is not, under present conditions, such as to justify any fear of more serious results, it is uncomfortable and possibly of some economic disadvantage to the men, and it is due to them that such studies as the above be made by the manufacturers of the hammer, or more especially by the soft-stone operators, since of those who use the pneumatic hammer it is their interests that are particularly involved.

PHYSICAL FATIGUE AS A FACTOR IN INCREASING SUSCEPTIBILITY TO COMMUNICABLE DISEASE.

Fatigue in its relation to health has been the subject of many investigations. With the beginning of the present world war and the immediate need for soldiers, sailors, and munitions, the question became one of great importance. The effects of fatigue in the making of soldiers, sailors, and munitions should be very carefully watched with a view to maintaining the output of training camps and munition factories at its highest level during the war. No necessary sacrifice of men should be questioned at this time, but when methods employed for speeding up this output are liable to "invite disaster," such methods should be carefully revised.

In the investigations made into the prevalence of communicable diseases by the Division of Sanitation, Bureau of Medicine and Surgery, Navy Department, the conclusion was reached that fatigue was a factor in their spread, and that "the attempt to make a sailor too rapidly is to invite disaster."

In view of these findings and their apparent relation to the civil population, and especially the industrial army, the reports are published here in full:

Notes on Preventive Medicine for Medical Officers, United States Navy.

Bulletin No. 12, Division of Sanitation.

DEPARTMENT OF THE NAVY,
BUREAU OF MEDICINE AND SURGERY,
Washington, D. C., February 15, 1918.

Epidemiological study of cerebrospinal fever under conditions obtaining in the Navy indicates that the incidence of carriers and the incidence of the disease must be considered separately. Where carriers are found it does not necessarily follow that cases of cerebrospinal fever will occur.

The dissemination of meningococci resulting in multiplication of carriers is due to causes which have been pointed out many times—overcrowding, close contact, bad ventilation, the prevalence of catarrhal infections with coughing and sneezing, mess gear or similar articles contaminated with fresh moist discharges from the nose and throat, etc.

Without the meningococcus cerebrospinal fever could not occur. On the other hand, it is now well known that although many persons in a camp may harbor the meningococcus in the nasopharynx, relatively few of the men exposed contract the disease, although many of them become meningococcus carriers. All meningococci may not be and probably are not virulent. Individuals vary in susceptibility, and indeed susceptibility seems to vary from time to time in the same individual. Other infections, age, exposure, fatigue, mental depression, digestive disturbances, lack of food, and unsuitable clothing, individually or collectively, undoubtedly play an important rôle.

Recent epidemiological study at the naval training stations at Great Lakes, Hampton Roads, and Norfolk, Va., has resulted in the accumulation of some interesting data relative to the factors which are concerned in causing an outbreak of this disease.

In the first place the normal 21-day period of detention was broken. This period of detention is the most important single factor in preventing the introduction of communicable disease and its spread on the station. This detention is necessary not only to detect carriers of such organisms as the diphtheria bacillus and the meningococcus, and to detect such diseases as measles and scarlet fever in their incubative stages, but also in order that sufficient time may be devoted to the preparation of recruits for the rigorous course of training to come. The recruit upon entering a naval training station, particularly in the wintertime, must adapt himself to a complete change in habits and environment. He must become accustomed to naval discipline, learn to take care of himself, become accustomed to a radical change in apparel, and to a change in diet; learn to sleep in a hammock in barracks, make new acquaintances, and possibly overcome a certain amount of homesickness.

Experience at the larger stations shows that these changes must be brought about gradually, because all these things have a decided influence in tending to lower resistance to infectious diseases. While the recruit is in detention it is necessary that he be immunized against smallpox, typhoid, and paratyphoid infections. It would be folly not to recognize that so potent an influence for good did not also have a certain degree of resistance-lowering influence, a further and important reason for avoiding strenuous training activities during the detention period. All in all, these views may be summarized in the statement that "the attempt to make a sailor too rapidly is to invite disaster."

The carrier problem is of the greatest importance, and, as already stated, overcrowding either in barracks, at moving-picture entertainments, or in other places of assembly, such as the Y. M. C. A. building, is an important factor in the dissemination of pathogenic organisms through the method of the droplet infection.

The great technical difficulties in the laboratory procedures for the detection of meningococcus and pneumococcus carriers, as well as the recognized intermissions of the carrier state, render it practically impossible to prevent the introduction of carriers into the training camp proper. Much of the success in eliminating carriers from the training station will depend upon the percentage of carriers in the civil population and the season of the year. The multiplication of carriers in the training camp proper will be restricted by limiting the number of men quartered in any one compartment, providing a proper amount of floor area for each man, and by the elimination of unnecessary points of contact.

There has been a striking parallelism in the incidence of cerebrospinal fever and lobar pneumonia at the naval training stations. It has also been noted that epidemics of bronchitis and coryza have preceded outbreaks of both of these diseases. Certain factors concerned in the development of either lobar pneumonia or cerebrospinal fever must be considered in contradistinction to the factors involved in the spread of the organisms. Experience seems to show that one of the most important of these is the fatigue factor. It is a well-recognized axiom that the prevalence of communicable disease is at a minimum among thoroughly seasoned and disciplined forces. In connection with the recent outbreak of communicable diseases at Great Lakes it may be observed that incoming detention was broken, and then for several thousand recruits the excellent but intensive system of training in vogue at that station was begun too early and too precipitately. About the same time two severe blizzards occurred and it was necessary to employ several thousand apprentice seamen to clear the roads and walks of snow, 3 to 6 feet deep. There was thus involved an unusual amount of hard work combined with exposure, which brought about a degree of fatigue and lowering of resistance to infection in many instances. Shortly thereafter there was a wide prevalence of bronchitis and coryza, followed by an outbreak of various communicable diseases of the respiratory type, including lobar pneumonia and cerebrospinal fever. The same sequence of events without the extra amount of work necessitated by the heavy fall of snow was noted at the Norfolk Training Station, where by reason of unprecedented weather the exposure was even greater because of poorer housing facilities and lack of heat and ventilation.

At Great Lakes the regiments which suffered most from the incidence of disease were three which were recruited in December and transferred to the training camp proper after only a few days in detention. The men of two of these regiments were subjected to the same kind of hard manual labor as that performed by older regiments. By the time that the last of these new regiments was recruited it was already recognized that new recruits could not be subjected to the same amount of exposure and work as the more seasoned men, and this regiment suffered less than the other two new regiments. During this period only a few cases of cerebrospinal fever occurred in the older regiments on the station.

In respect to the length of time which those who became ill with the disease had been on the station it may be said that no cases developed until the third week and that the outbreak reached its height between the sixth and seventh weeks, after which it rapidly declined.

The lack of an outgoing detention camp, equal in capacity to that used for incoming detention, contributed to the introduction of disease into other stations. Without a full period of outgoing detention the transference of infection from one station to another is almost certain to occur.

In conclusion it will do no harm to repeat that from the standpoint of preventive medicine "the attempt to make a sailor too rapidly is to invite disaster."

Bulletin No. 13, Division of Sanitation.

DEPARTMENT OF THE NAVY,
BUREAU OF MEDICINE AND SURGERY,
Washington, D. C., February 22, 1918.

Physical fatigue, from the standpoint of preventive medicine, must be given careful consideration as one of the important etiological factors tending to lower blood and tissue resistance to infectious diseases, with special reference to cerebrospinal fever, lobar pneumonia, and other coccus infections.

Epidemiological investigations indicate that body fatigue plays an important rôle, potentially, in an outbreak of communicable disease in a closely housed military organization when the source of infection is present. In fact, in the training of recruits it may be the most prominent factor in determining the number of individuals who will become ill following exposure, if immediate steps are not taken, after early detection of disease and prompt isolation of patients, to interdict physical exertion and to place those not already ill under the best possible circumstances favorable to physical well-being. Mental depression or nerve fatigue, which is not to be differentiated altogether, either from the secretory state of the thyroid and other ductless glands or from muscle fatigue, deserves consideration as a subject unto itself, and is not to be touched upon here except in so far as nerve fatigue is associated with muscle fatigue.

In a previous number attention was directed to some of the untoward results which follow unwise attempts to hasten the early training of naval recruits. Competitive athletics have for years played a very prominent part in the national life, and it is perhaps natural for college experience and college methods of training to influence, more or less, those engaged in the training of recruits, especially now when it is necessary to expand the Navy quickly.

It must be borne in mind, however, that in the training for competitive athletics ordinarily everything in the system of training is subordinated to the object of winning the big final event of the year, and usually, too, the system is calculated to eliminate all but the most fit and to develop, with scant regard to the danger of causing some permanent physical damage, the few remaining to the desired point where a temporary and not to be maintained state of physical power is reached. Such methods obviously are not to be considered in fitting men for arduous manual occupations. They are not used even in training teams for professional baseball, a seasonal occupation which begins each year with easy work for previously trained athletes. Somewhere between the natural hardening of the laborer and the systematic training for the baseball season lies the happy medium which should guide in the training of recruits. It may be taken for granted that the training should begin gently, particularly as a large majority of the recruits are young and physically immature.

There are certain principles which may be laid down as the result of practical experience in training men physically, and in preparing them for athletic contests. Where men are trained in groups, physical strain should be regulated so that the weaker members will not suffer. The speed of the whole group should be governed to protect the weaker physiques. If it is considered necessary to train the older and stronger recruits expeditiously, the younger and less developed should be placed in a separate group and a more moderate application of training methods should be made, thus gradually bringing them up to the point of maximum efficiency. If the potentially strong are developed at the expense of the less fit, an unnecessarily large number of the latter must be lost to the service through medical survey for physical disability of one kind or another. Of course, it is recognized that military training is calculated quite properly, to eliminate men who are constitutionally unfit, mentally or physically, but for economic reasons undue prodigality with the excellent recruit material now available for training will serve no good purpose.

Some college trainers have developed winning teams by a system under which the weaker physiques are quickly eliminated, leaving only the most fit to be coached into final form. These trainers have had an abundance of material to work with, of course, and they have had no consideration for the harm done to those eliminated during the period of training. There have been other very successful trainers, who, forced, perhaps, by a comparative scarcity of material, have preferred to give careful consideration to men less perfect in physique; to conserve vitality always, and to develop gradually those of weaker physique. These men in the end generally obtain even better results than those who use the more forceful method. The conservation method was consistently carried out for years by a famous varsity crew coach. Quite frequently he would take under his observation a freshman who to the average trainer would have offered little promise of developing into varsity material. By a system of carefully graduated exercises and constant supervision he would bring such an individual to a state where after three years he would make the first crew in a boat which was accustomed to win the big event year after year. It is needless to say that many of his athletes would not only have failed to make the crew under forced training but some of them would doubtless have suffered irreparable physical damage.

In many instances the accumulation of fatigue substances incident to excessive metabolism taking place during the course of a single long race, where fatigue has occurred before reaching the goal, has made it necessary to put an athlete to bed for several days in order to enable him to recuperate sufficiently to enter another event a week or 10 days later. Had such students been brought into contact with sources of infection, it is not to be doubted that they would have contracted in severe form communicable diseases to which they were at other times comparatively immune. It is a common experience to observe a lessened immunity to staphylococcus infection among athletes undergoing hard training, especially as they approach the point of becoming overtrained or "stale."

Applied physical exercises in ordinary drills, continued day after day, even in comparatively small dosage, without proper periods of rest, will have the same effect as a short period of physical strain carried to the limit of endurance. Many men in training for athletic contests never reach the point of making the first team. They drop out finally because of damage done to their hearts and nervous systems. Too close an analogy should not be drawn between systems of training for athletic events and the daily drills and setting-up exercises incident to the training of naval recruits, but, after all, the effect on the individual is very similar and the same bad results occur if the training is forced. The cumulative effects of fatigue, caused by smaller doses of physical exercise improperly prolonged, and without suitable rest periods, produce in the end the same kind of physical damage. In fact, the development of the individual may be retarded or actually prevented.

It may be laid down as a general principle that for men under training no drill or physical exercise should cause such a degree of fatigue that reaction fails to follow quickly after a brief rest. To quote Medical Inspector J. A. Murphy, United States Navy:

> Strenuous effort should be approached slowly, as the exercises are not used to test the limit of power. Prolonged effort is to be avoided in order that a condition of stimulation will occur rather than exhaustion. Exercise should produce the simple symptoms of physical activity, such as a general sense of warmth and well-being, animation, sparkling eyes, cheerfulness, and mental exhilaration, instead of the opposite effect of overactivity, such as a vague sensation of discomfort about the heart, with constricting girdle sense, obscuration of vision, confused ideas, blunted sensation, and air hunger.

Drills should stop at the point where the men will look forward to subsequent drills with pleasure rather than to regard them as laborious tasks. Certainly after a short rest and a shower all men should emerge clear of eye and physically alert.

The old saying, "haste makes waste," can be substantiated by scientific investigation. Training methods which take into consideration different degrees of physical development and endurance will result not only in reduced admission rates for disease but will develop from the men who begin the course of training the maximum number capable of maintaining a high standard of physical fitness. In connection with speeding-up methods, investigations in munition factories have shown that the output in a working day of eight hours—two four-hour periods—was materially increased by taking 10 minutes for rest out of each four-hour period. It was also shown that the night shift which was required to work nine hours—divided into a four and a five hour period—gave results in the four-hour period which did not differ materially from those given in the first day period, but during the five-hour period very little output was secured in the last hour. By eliminating an hour from this period the total output for the night shift was actually increased.